

A Review of “Top-down facilitation of visual object recognition: Object-based and context-based contributions” by Fenske, Aminoff, and Bar (2006)

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OCTOBER 15, 2015

What is bottom-up facilitation?

- **Bottom-up is the traditional model**
- A “bottom-up cascade of cortical regions” processes visual information in order from least to most complex (p. 4)
- Parsimonious with the hierarchal architecture of the visual cortex

What is bottom-up facilitation?

- However, recent evidence suggests that top-down facilitation plays a role.
- **But, how it works remains a mystery.**
- Fenske et al. propose a possible model.

What is top-down facilitation?

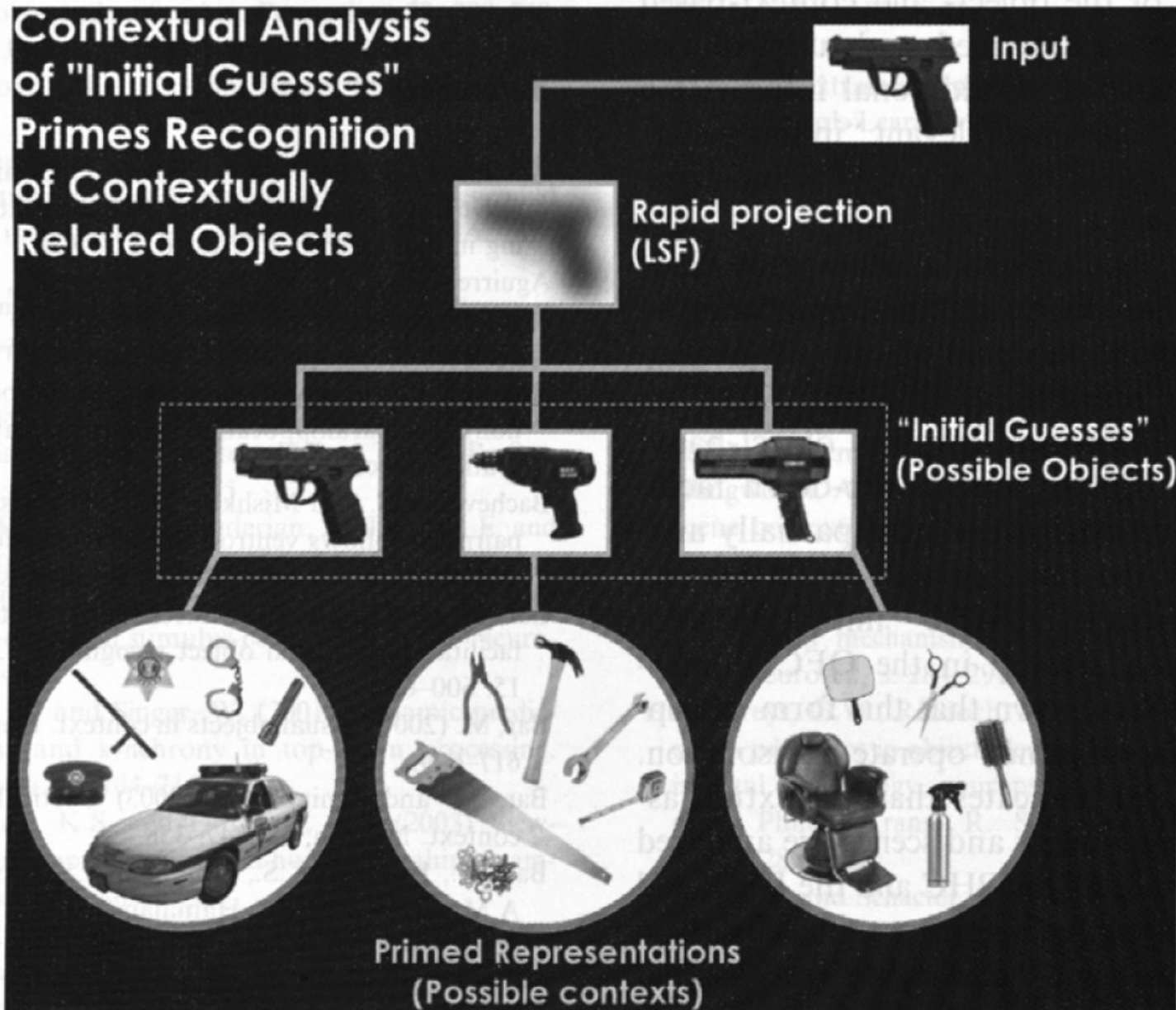
- A cortical or subcortical “shortcut” (p. 4)
- An image of low spatial frequency (LSF) is piped directly to the prefrontal cortex (PFC), allowing predictive preparations to be made.

What is top-down facilitation?

TWO mechanisms:

- **Object-based**
- **Context-based**

Contextual Analysis of "Initial Guesses" Primes Recognition of Contextually Related Objects



(Fenske et al., 2006, p. 17)

Object-based mechanism

A fuzzy image of an object is rapidly projected to the prefrontal cortex (PFC). The PFC gives its "initial guesses" to the temporal cortex, which presensitizes multiple sets of contextually related items, based on memories / past experiences, simultaneously.

Explains why showing a gun can facilitate later recognition of a hairbrush, according to Fenske et al (2006).

What is top-down facilitation?

“Importantly, this object-based mechanism allows early information about an object to act as the **catalyst** for top-down enhancement of its own bottom-up cortical processing” (p. 6).

Do not just think of this as an either/or argument. Both types may coexist and interact.

What is top-down facilitation?

- Contextual **consistency** helps our brains!
- You do **not** expect to see a fire extinguisher at the beach or a surfboard in a kitchen.
- Visual object recognition is aided by contextual information. This has experimental support.

~ 7% RT
difference

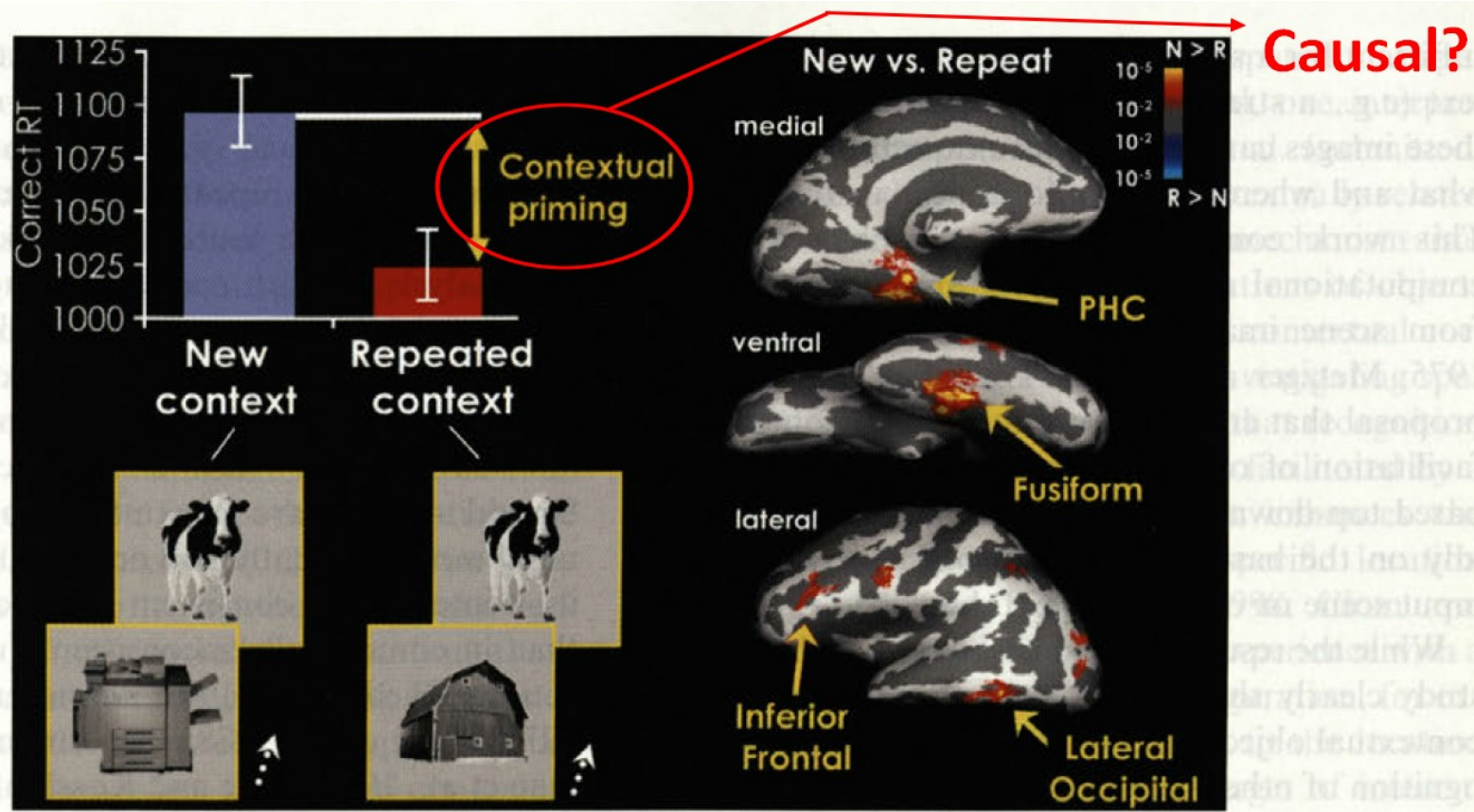


Fig. 10. Contextual facilitation of object recognition. Objects preceding repeated-context target items were always contextually related; objects preceding new-context items were never contextually related. After each picture presentation, participants were required to respond “bigger than a shoebox,” or “smaller than a shoebox,” by a key-press. Contextual priming was reflected by faster response times (RT) and reduced cortical fMRI response for repeated-context objects than for new-context objects. Contextual priming related fMRI response reductions occurred in the parahippocampal component of the context network, and in object-related regions of occipito-temporal and inferior frontal cortices.

(Fenske et al.,
2006, p. 13)

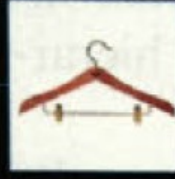
Context-based
mechanism

Does it fit in a
shoebox? A
huge printer
obviously
doesn't, but
this takes more
time to identify
out-of-context.

Red-colored
annotations by
Richard Thripp.

Inferior temporal cortex

Closet



Beach

Store

Sun

Vacation

Abstract Associations



Parahippocampal cortex

(Adapted from Bar, 2004, by Fenske et al., 2006, p. 12)

Context-based mechanism

Some objects may easily be associated with **multiple** contexts, while others may **strongly** be associated with only one or two contexts.

A bathing suit might be associated with a closet, store, and the beach.

Seaweed would only be associated with the beach.

Identifying a strong contextual cue **constrains** the search parameters.

Discussion

Fenske et al. say that a “lifetime of experience with contextual associations” (p. 18) guides top-down recognition. What happens when the experience isn’t there, or doesn’t fit the environment?

(Perhaps: consider objects out of place, “culture shock,” exotic travel, shut-ins, sci-fi movies, etc.)

Discussion

An **open** question: How does nonspatial (e.g., semantic) information relate with spatial information (pp. 14–15)? Are they separate, highly integrated, or loosely connected?

Non-spatial example: Expecting a computer monitor to be in a home office.

Spatial example: Expecting the monitor to be on the computer desk, not in a drawer under the desk.

Discussion

Open floor:

Discuss salient quotes, concepts, and your **reactions** to the Fenske et al. (2006) article. Bonus points* for relating it to other readings and the wider field of object recognition in general.

* There are no bonus points.

Reference

Fenske, M. J., Aminoff, E., Gronau, N., & Bar, M. (2006). Chapter 1: Top-down facilitation of visual object recognition: Object-based and context-based contributions. *Progress in Brain Research, 155*, 3–21. doi:10.1016/S0079-6123(06)55001-0